Vidyasagar University

Curriculum for B.Sc. (Honours) in Electronics [Choice Based Credit System]

Semester-V

Course	Course Code	Name of the Subjects	Course Type/ Nature	Teaching Scheme in hour per week			Credit	Marks
				L	T	P		
CC- 11		C11T: Electronic Instrumentation	Core Course-11	4	0	0	6	75
		- Lab		0	0	4		
CC- 12		C12T: Microprocessor and Microcontrollers	Core Course-12	4	0	0	6	75
		- Lab		0	0	4		
DSE-1		**DSE1T**: Semiconductor Fabrication and Characterization **Or** Power Electronics **Or** Numerical Techniques **Or** Electrical Machines	Discipline Specific Electives -1	4	0	0	6	75
		- Lab		0	0	4		
DSE-2		DSE2T: Nano Electronics **Or** Transmission Lines, Antenna and Wave Propagation **Or** Control Systems	Discipline Specific Electives -2	4	0	0	6	75
		- Lab		0	0	4		
Semester Total							**24**	**300**

L= Lecture, **T=** Tutorial, **P =** Practical, **CC -** Core Course, **TBD -** To be decided, **DSE:** Discipline Specific Elective.

Semester-V

List of Core Course (CC)

CC-11: Electronic Instrumentation

CC-12: Microprocessor and Microcontrollers

Discipline Specific Electives (DSE)

DSE-1: Semiconductor Fabrication and Characterization
Or
DSE-1: Power Electronics
Or
DSE-1: Numerical Techniques
Or
DSE-2: Electrical Machines

DSE-2: Nano Electronics
Or
DSE-2: Transmission Lines, Antenna and Wave Propagation
Or
DSE-2: Control Systems

SEMESTER –V

Core Courses (CC)

CC-11: Electronic Instrumentation Credits 06

CC11T: Electronic Instrumentation Credits 04

Course Contents:

Qualities of measurement: Basic Measurement Instruments & Connectors and Probes

Qualities of Measurement: Specifications of instruments, their static and dynamic characteristics, Error (Gross error, systematic error, absolute error and relative error) and uncertainty analysis. Statistical analysis of data and curve fitting.

Basic Measurement Instruments: PMMC instrument, galvanometer, DC measurement - ammeter, voltmeter, ohm meter, AC measurement, Digital measurement systems (voltmeter, multimeter, frequency meter)

Connectors and Probes: low capacitance probes, high voltage probes, current probes, identifying electronic connectors – audio and video, RF/Coaxial, USB etc

Measurement of resistance and Impedance & A-D and D-A Conversion:

Measurement of Resistance and Impedance: Low Resistance: Kelvin's double bridge method, Medium Resistance by Voltmeter Ammeter method, Wheatstone bridge method, High Resistance by Megger. A.C. bridges, Measurement of Self Inductance, Maxwell's bridge, Hay's bridge, and Anderson's bridge, Measurement of Capacitance, Schering's bridge, DeSauty's bridge, Measurement of frequency, Wien's bridge.

A-D and D-A Conversion: 4 bit binary weighted resistor type D-A conversion, circuit and working. Circuit of R-2R ladder. A-D conversion characteristics, successive approximation ADC. (Mention of relevant ICs for all).

Oscilloscope & Signal Generators:

Oscilloscopes: CRT, wave form display and electrostatic focusing, time base and sweep synchronization, measurement of voltage, frequency and phase by CRO, Oscilloscope probes, Different types of scope: Block diagram, principle and working, Advantages and applications, CRO specifications (bandwidth, sensitivity, rise time).

Signal Generators: Audio oscillator, Pulse Generator, Function generators.

Transducers and Sensors:

Classification of transducers, Basic requirement/characteristics of transducers, active & passive transducers, Resistive (Potentiometer, Strain gauge – Theory, types), Capacitive (Different types), Inductive (LVDT) and piezoelectric transducers.Measurement of displacement, velocity and acceleration (translational and rotational). Measurement of pressure (manometers, diaphragm, bellows), Measurement of temperature (RTD, thermistor, thermocouple, semiconductor IC sensors), Light transducers (photoresistors, photovoltaic cells, photodiodes).

Instrumentation Amplifier - circuit, transfer function and advantage.

Suggested Readings:

1. H. S. Kalsi, Electronic Instrumentaion, TMH(2006)
2. W.D. Cooper and A. D. Helfrick, Electronic Instrumentation and Measurement Techniques, Prentice- Hall (2005).
3. Nakra B C, Chaudry K, Instrumentation Measurement and analysis: TMH
4. E.O.Doebelin, Measurement Systems: Application and Design, McGraw Hill Book - fifth Edition (2003).
5. Joseph J Carr, Elements of Electronic Instrumentation and Measurement, Pearson Education (2005)
6. David A. Bell, Electronic Instrumentation and Measurements, Prentice Hall (2013).
7. Oliver and Cage, "Electronic Measurements and Instrumentation", TMH (2009).
8. Alan S. Morris, "Measurement and Instrumentation Principles", Elsevier (ButerworthHeinmann- 2008).
9. K Sawhney, Electrical and Electronics Measurements and Instrumentation, DhanpatRai and Sons (2007).
10. S. Rangan, G. R. Sarma and V. S. Mani, Instrumentation Devices and Systems, Tata Mcgraw Hill (1998).

C11 P: Electronic Instrumentation Lab **Credits 02**

Practical:

1. Design of multi range ammeter and voltmeter using galvanometer.
2. Measurement of resistance by Wheatstone bridge and measurement of bridge sensitivity.
3. Measurement of Capacitance by de'Sautys.
4. Measure of low resistance by Kelvin's double bridge.
5. Design and implementation of Instrumentation Amplifier using 741 OOPAMP.
6. To determine the Characteristics of resistance transducer - Strain Gauge (Measurement of Strain using half and full bridge).
7. To determine the Characteristics of LVDT.
8. To determine the Characteristics of Thermistors.
9. Measurement of temperature by Thermocouples and study of transducers like AD590 (two terminal temperature sensor), PT-100, J- type, K-type.
10. To study the Characteristics of LDR, Photodiode, and Phototransistor:

    (i) Variable Illumination.

(ii) Linear Displacement.

11. Design and Implementation of a Temperature Controller.

CC-12: Microprocessor and Microcontrollers — Credits 06

C12T: Microprocessor and Microcontrollers — Credits 04

Course Contents:

Introduction to Microprocessor

Introduction to Microprocessor: Introduction, Applications, Basic block diagram, Speed, Word size, Memory capacity, Classification of microprocessors (mention of different microprocessors being used)

Microprocessor 8085: Features, Architecture -block diagram, General purpose registers, register pairs, flags, stack pointer, program counter, and types of buses. Multiplexed address and data bus, generation of control signals, pin description of microprocessor 8085. Basic interfacing concepts, Memory mapped I/O and I/O mapped I/O, Partial/full memory decoding,DMA
8085 Instructions: Operation code, Operand & Mnemonics. Instruction set of 8085, instruction classification, addressing modes, instruction format. Data transfer instructions, arithmetic instructions, increment & decrement instructions, logical instructions, branch instructions and machine control instructions. Assembly language programming examples.

Interfacing with PPI (8255) , ADC (0808 etc.)
Stack operations, subroutine, and call and return instructions. Delay loops, use of counters, timing diagrams-instruction cycle, machine cycle, T- states, time delay.
Interrupt structure of 8085A microprocessor, processing of vectored and non-vectored interrupts, latency time and response time; Handling multiple interrupts

Introduction to Microcontrollers
Microcontrollers: Introduction, different types of microcontrollers, embedded microcontrollers, processor architectures. Harvard vs. Princeton, CISC vs. RISC architectures, microcontroller memory types, microcontroller features, clocking, I/O pins, interrupts, timers, peripherals.

PIC16F887

PIC16F887 Microcontroller: Core features, Architecture, pin diagram, memory organization- Program and data memory organization, I/O Ports, oscillator module, Timer modules (Timer 0, Timer 1 and Timer 2), comparator module, analog-to-digital converter (ADC) module, data EEPROM, Enhanced capture/compare/PWM module, EUSART, master synchronous serial port (MSSP) module, special features of the CPU, interrupts, addressing modes, instruction set.

Interfacing to PIC16F887
LED, Switches, Solid State Relay, Seven Segment Display, 16x2 LCD display, 4x4 Matrix Keyboard, Digital to Analog Converter, Stepper Motor and DC Motor. Interfacing program examples using C language.

Suggested Readings:

1. Microprocessor Architecture, Programming and Applications with 8085, Ramesh S.Gaonkar - Wiley Eastern Limited- IV Edition.
2. Fundamentals of Microprocessor & Microcomputer: B. Ram—Danpat Rai Publications.
3. Microchip PIC16F87X datasheet
4. PIC Microcontrollers, Milan Verle, ,mikroElektronika, 1st edition (2008)
5. Muhammad Ali Mazidi, "Microprocessors and Microcontrollers", Pearson, 2006.
6. MathurMicroprocessor 8085 and Its Interfacing, 2nd ed. • PHI
7. Krishna Kant Microprocessors and Microcontrollers: Architecture, Programming and System Design, 2nd ed. • PHI
8. Mazidi AVR Microcontroller and Embedded Systems: Using Assembly and C ,Pearson
9. Mazidi PIC Microcontroller And Embedded Systems ,Pearson

C12P: Microprocessor and Microcontrollers Lab **Credits 02**

Practical:

Assembly language programs

1. Program to transfer a block of data.
2. Program for multibyte addition
3. Program for multibyte sub-traction
4. Program to multiply two 8-bit numbers.
5. Program to divide a 16 bit number by 8 bit number.
6. Program to search a given number in a given list.
7. Program to generate terms of Fibonacci series.
8. Program to find minimum and maximum among N numbers
9. Program to find the square root of an integer.
10. Program to find GCD of two numbers.
11. Program to sort numbers in ascending/descending order.
12. Program to verify the truth table of logic gates.

PIC Microcontroller Programming

1. LED blinking with a delay of 1 second.
2. Solid State Relay Interface
3. Interfacing of LCD (2X16).
4. Interfacing of stepper motor and Rotating stepper motor by N steps clockwise/anticlockwise with speed control.

5. To test all the gates of a given IC74XX is good or bad.
6. Generate sine, square, saw tooth, triangular and staircase waveform using DAC interface.
7. Display of 4- digit decimal number using the multiplexed 7-segment display interface.
8. Analog to digital conversion using internal ADC and display the result on LCD.
9. Implementation of DC-Volt meter (0-5V) using internal ADC and LCD
10. Digital to analog conversion using PWM (pulse delay to be implemented using timers).
11. Speed control of DC motor using PWM (pulse delay to be implemented using timers).
12. Interfacing of matrix keyboard (4X4).
13. Serial communication between microcontroller and PC.

Discipline Specific Electives (DSE)

DSE-1: Semiconductor Fabrication and Characterization — Credits 06

DSE1T: Semiconductor Fabrication and Characterization — Credits 04

Course Contents:

Introduction of Semiconductor Process Technology, Epitaxy deposition, and Characterization

Introduction of Semiconductor Process Technology (Line width – 10 nm technology), Semiconductor materials, single crystal, polycrystalline and amorphous, Crystal growth techniques: Si from the Czochralski technique, starting material, Distribution of dopants, Effective Segregation Coefficient. Silicon Float Zone Process, GaAs from Brigdman techniques. Wafer preparation.

Epitaxy Deposition: Epitaxial growth by vapor phase epitaxy (VPE) and molecular beam epitaxy (MBE).

Characterization: Various characterization methods for structural, electrical and optical properties. Basic idea of X-ray diffractometer, Scanning electron microscope, Transmission electron microscope and UV-VIS-NIR spectrophotometer.

Oxidation and Diffusion

Oxidation: Thermal Oxidation Process: Kinetics of Growth for thick and thin Oxide, Dry and Wet oxidation. Effects of high pressure and impurities, Impurity Redistribution during Oxidation, Masking property of Silicon Oxide, Oxide Quality. Chemical vapour deposition of silicon oxide, properties of silicon oxide, step coverage, P-glass flow.

Diffusion: Basic Diffusion Process: Diffusion Equation, Diffusion Profiles. Extrinsic Diffusion Concentration Dependent Diffusivity. Lateral Diffusion. Doping through Ion Implantation and its comparison with diffusion.

Lithographic Processes and Etching

Lithographic Processes: Clean room, Optical lithography, exposure tools, masks, Photoresist, Pattern Transfer, and Resolution Enhancement Technique. Electron Beam Lithography, X-ray Lithography and Ion Beam Lithography. Comparison between various lithographic techniques.

Etching: Wet Chemical Etching-basic process and few examples of etchants for semiconductors, insulators and conductors; Dry etching using plasma etching technique, lambda rule, scaling rules.
Metallization: Uses of Physical Vapor Deposition and Chemical Vapor Deposition technique for Aluminum and Copper Metallization.

Process Integration

Passive components- Integrated Circuit Resistor, Integrated Circuit Inductor, Integrated Circuit Capacitor. Bipolar Technology: Basic fabrication process, Isolation techniques. MOSFET Technology: Basic fabrication process of NMOS, PMOS and CMOS technology.

Suggested Readings:

1. Gary S.May and S.M.Sze , Fundamentals of Semiconductor Fabrication, John Wiley& Sons(2004)
2. Ludmila, Eckertova, Physics of Thin films, 2nd Edition, Plenum Press (1986).
3. Ghandhi, VLSI Fabrication Principles Wiley
4. S. M. Sze, Semiconductor Devices : Physics & Technology 3e Wiley.
5. Plummer, Silicon VLSI Technology Pearson
6. Weste, CMOS VLSI Design: A Circuits and Systems Perspective, 4e Pearson
7. Campbell, Science & Engineering Of Microelectronic Fabrication 2e Oxford

DSE1P: Semiconductor Fabrication and Characterization Lab Credits 02

Practical:

1. To measure the resistivity of semiconductor crystal with temperature by four –probe method.

2. To determine the type (n or p) and mobility of semiconductor material using Hall- effect.

3. Oxidation process Simulation

4. Diffusion Process Simulation

5. To design a pattern using photolithographic process and its simulation

6. Process integration simulation

7. Fabrication of thin film using Spin Coating/Thermal Coating System.

8. Determination of Optical Bandgap through transmission spectra. [expensive]

*** In case of non-availability of equipment simulation studies may be done in lieu of the last two experiments.**

Or

DSE-1: Power Electronics Credits 06

DSE1T: Power Electronics Credits 04

Course Contents:

Power Devices and SCR

Power Devices: Need for semiconductor power devices, Power diodes, Enhancement of reverse blocking capacity, Introduction to family of thyristors.
Silicon Controlled Rectifier (SCR): structure,two transistor analogy, I-V characteristics, Turn-On and Turn-Off characteristics, ratings, Factors affecting the characteristics/ratings of SCR, Gate-triggering circuits,dv/dttriggeringcircuits, Control circuits design and Protection circuits, Snubber circuit

Diac&Triac, IGBT, Application of SCR and Power MOSFETs

Diac and Triac: Basic structure, working and V-I characteristic of, application of a Diac as a triggering device for a Triac.
Insulated Gate Bipolar Transistors (IGBT): Basic structure, I-V Characteristics, switching characteristics, device limitations and safe operating area (SOA) etc.
Application of SCR: SCR as a static switch, phase controlled rectification, single phase half wave, full wave and bridge rectifiers with inductive & non-inductive loads; AC voltage control using SCR and Triac as a switch.
Power MOSFETs: operation modes, switching characteristics, power BJT, second breakdown, saturation and quasi-saturation state.

Power Inverters and Choppers
Power Inverters: Need for commutating circuits and their various types, d.c. link invertors, Parallel capacitor commutated invertors with and without reactive feedback and its analysis, Series Invertor, limitations and its improved versions, bridge invertors.
Choppers: basic chopper circuit, types of choppers(Type A-D), step-down chopper, step-up chopper, operation of d.c. chopper circuits using self-commutation (A & B-type commutating circuit), cathode pulse turn-off chopper(using class D commutation), load sensitive cathode pulse turn-off chopper (Jones Chopper), Morgan's chopper

Electromechanical Machines

DC Motors, Basic understanding of field and armature, Principle of operation, EMF equation, Back EMF, Factors controlling motor speed, Thyristor based speed control of dc motors, AC motor (Induction Motor only), Rotor and stator, torque& speed of induction motor, Thyristor control of ac motors(block diagrams only).

Suggested Readings:

1. Power Electronics, P.C. Sen, TMH
2. Power Electronics & Controls, S.K. Dutta
3. Power Electronics, M.D. Singh & K.B. Khanchandani, TMH
4. Power Electronics Circuits, Devices and Applications, 3rd Edition, M.H. Rashid, Pearson Education
5. Power Electronics, Applications and Design, Ned Mohan, Tore.

6. Power Electronics, K. HariBabu, Scitech Publication.
7. Power Electronics, M.S. Jamil Asghar, PHI.
8. A Textbook of Electrical Technology-Vol-II, B.L. Thareja, A.K. Thareja, S.Chand

DSE1P: Power Electronics Lab **Credits 02**

Practical:

1. Study of I-V characteristics of DIAC
2. Study of I-V characteristics of a TRIAC
3. Study of I-V characteristics of a SCR
4. SCR as a half wave and full wave rectifiers with R and RL loads.
5. AC voltage controller using TRIAC with UJT triggering.
6. Study of parallel and bridge inverter.
7. Design of snubber circuit.
8. VI Characteristic of MOSFET and IGBT (Both).
9. Study of chopper circuits.

Or

DSE-1: Numerical Techniques Credits 06

DSE1T: Numerical Techniques **Credits 04**

Course Contents:

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Numerical Methods and Study of Transcendental & Polynomial Equation f(x) = 0

Numerical Methods: Floating point, Round-off error, Error propagation, Stability, Programming errors. Solution of Transcendental and Polynomial Equations f(x)=0: Bisection method, Secant and Regula Falsi Methods, Newton Raphson method, Rate of convergence, General Iteration Methods, Newton's Method for Systems, Method for Complex Roots , Roots of Polynomial Equations.

Interpolation and Polynomial approximation and Curve fitting

Interpolation and Polynomial Approximations: Taylor Series and Calculation of Functions, Langrange Interpolation, Newton Divided Difference Interpolation (forward and backward difference formulae), Truncation errors.
Curve Fitting: Least square fitting, Curve fitting, Interpolation by Spline functions.

Numerical Integration, Numerical Differentiation and Numerical methods for first order differential equations

Numerical Integration: Trapezoidal Rule, Error bounds and estimate for the Trapezoidal rule, Simpson's Rule, Error of Simpson's rule.

Numerical Differentiation: Finite difference method and applications to electrostatic boundary value problems.
Numerical methods for first order differential equations: Euler-Cauchy Method, Classical RungeKutta method of fourth order. Methods for system and higher order equations.

Numerical Methods in Linear Algebra and Matrix Eigenvalue

Numerical Methods in Linear Algebra: Linear systems Ax=B, Gauss Elimination, Partial Pivoting, Matrix Inversion, Gauss-Jordon, Iterative Methods: Gauss-Seidel Iteration, Jacobian Iteration.
Matrix Eigenvalue: Power Method.

Suggested Readings:

1. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons (1999).
2. V.Rajaraman, Computer Oriented Numerical Methods, Prentice Hall India, Third Edition.
3. S. S. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall India (2008).
4. M. K. Jain, S. R. K. Iyengar and R. K. Jain, Numerical Methods: Problems and Solutions, New Age International (2007).
5. B.S. Grewal, Numerical Methods in Engineering and Science with Programs in C and C++, Khanna Publishers (2012).
6. Thangaraj, Computer-Oriented Numerical Methods, PHI

DSE1P: Numerical Techniques Lab **Credits 02**

Practical:

1. Program to implement Bisection Method
2. Program to implement Secant Method
3. Program to implement Regula falsi method
4. Program to implement Newton Raphson Method
5. Program to implement Trapezoidal rule
6. Program to implement Simpson's rule
7. Program to implement Runge Kutta Method
8. Program to implement Euler-Cauchy Method
9. Program to implement Gauss-Jordon Method
10. Program to implement Gauss-Seidel Iteration

Or

DSE-1: Electrical Machines Credits 06

DSE1T: Electrical Machines Credits 04

Course Contents:

DC Machines, Generators and Motors:

DC Machines: Basic constructional features and physical principles involved in electrical machines, armature winding (ac and dc), lap and wave connections, different types of pitches

D.C. Generators: Construction and principles of operation, brief idea about armature reaction and commutation, E.M.F. Equation, Methods of excitation, and Characteristics of Self excited and separately (Shunt and Series) excited generators, Losses and efficiency, applications.

D.C. Motors: Comparison of generator and motor action & interchangeability, principle of operation, significance of back EMF, maximum power, Torque and speed relation, Characteristics of series, shunt and excited motors & applications, losses & efficiency, necessity of motor starters, Three point starter, Speed control of DC motors, electronic speed control of DC motors.

Single phase transformer.

Principle, construction and operation, phasor diagrams, equivalent circuits, parameters from open and short circuit tests, load tests, temperature rise, different losses, efficiency, regulation) These should added.

Poly Phase Induction Motors and Single Phase Motors:

Poly Phase Induction Motors: General constructional features, Types of rotors, Rotating magnetic field , Induction motor as a generalized transformer, equivalent circuit, Production of torque, Slip, Torque equation, Torque-slip characteristics. Comparison with DC motor

Single Phase Motors: Single phase induction motors, double revolving field theory , Split phase motors, capacitor start motors, capacitor start & run motors, Stepper Motor, Universal motor, Brush less DC motor and PMDC motor .

Synchronous Machines:

Synchronous Machines: Brief construction details of three phase synchronous generators,
E.M.F. equation, excitation system for synchronous generator.

Suggested Readings:

1. I. J. Nagrath and D. P. Kothari, Electrical Machines, Tata McGraw Hill
2. G. Mc. Pherson, An introduction to Electrical Machines & Transformers, John Wiley & Sons
3. H. Cotton, Advanced Electrical Technology, CBS Publishers and Distributors, New Delhi
4. S. Ghose, Electrical Machines, Pearson Education
5. N. K. De and P. K. De, Electric Drives, Prentice Hall of India
6. Ashfaq Husain, Electrical Machines, Dhanpat Rai & Co.
7. B.L. Thareja, A.K. Thareja, A Textbook of Electrical Technology-Vol-II, S.Chand

DSE1P: Electrical Machines Lab **Credits 02**

Practical:

1. Study of characteristics of DC Series motor.

2. Speed Control of DC Shunt motor.
3. Study of Load characteristics of single phase induction motor.
4. Study of Load characteristics of three phase squirrel cage induction motor.
5. Study of speed control of shunt DC motor using SCR.
6. Study of Open Circuit Test on single phase transformer.
7. Study of Short Circuit Test on single phase transformer.

DSE-2: Nano Electronics   Credits 06

DSE2T: Nano Electronics   **Credits 04**

Course Contents:

Introduction to Nano electronics

Introduction: Definition of Nano-Science and Nano Technology, Applications of Nano- Technology.
Introduction to Physics of Solid State: Size dependence of properties, bonding in atoms and giant molecular solids, Electronic conduction, Systems confined to one, two or three dimension and their effect on property

Quantum Theory for Nano Science: Time dependent and time independent Schrodinger wave equations. Particle in a box, Potential step: Reflection and tunneling (Quantum leak). Penetration of Barrier, Electron trapped in 2D plane (Nano sheet), Quantum confinement effect in nano materials.
Quantum Wells, Wires and Dots: Preparation of Quantum Nanostructure; Size and Dimensionality effect, Fermi gas; Potential wells; Partial confinement; Excitons; Single electron Tunneling,Coulomb Blockade, Density of States for confinement in one,two and three dimension, Infrared detectors; Quantum dot laser Superconductivity.Balliistic transport

Growth Techniques of Nanomaterials

Synthetic aspects: bottom up and top down approaches, Lithograpahic and Nonlithograpahic techniques, Sputtering and film deposition in glow discharge, DC sputtering technique (p-CuAlO2 deposition). Thermal evaporation technique, E-beam evaporation, Chemical Vapour deposition(CVD), Synthesis of carbon nano-fibres and multi-walled carbon nanotubes, Pulsed Laser Deposition, Molecular beam Epitaxy, Sol-Gel Technique (No chemistry required), Synthesis of nanowires/rods, Electro deposition, Chemical bath deposition, Ion beam deposition system, Vapor-Liquid –Solid (VLS) method of nanowireguage

Methods of Measuring Properties and Characterization techniques:

Microscopy: Scanning Probe Microscopy (SPM), Atomic Force Microscopy (AFM), Field Ion Microscopy, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM) including energy dispersive X-ray (EDX) analysis, low energy electron diffraction (LEED), reflection high energy electron diffraction (RHEED)

Spectroscopy: Infra-red and Raman Spectroscopy, X-ray Spectroscopy, Magnetic resonance, Optical and Vibrational Spectroscopy

Application of Nano electronics

Carbon nanotubes, nano cuboids, graphene, carbon quantum dots: Fabrication, structure. Electrical, mechanical, and vibrational properties and applications. Use of nano particles forbiological application, drug delivery and bio-imaging, Impact of nanotechnology on the environment.

Suggested Readings:

1. Hanson,Fundamentals of Nanoelectronics Pearson
2. Nano-scale Science and Technology, Robert W. Kelsall, Ian W. Hamley and Mark Geoghegan, John Wiley & Sons, Ltd., UK, 2005.
3. Nanomaterials: synthesis, properties and applications, Institute of Physics, 1998.
4. Introduction to Nanotechnology, Charles P. Poole Jr and Frank J. Owens, Wiley Interscience, 2003.
5. Chattopadhyay & Banerjee Introduction to Nanoscience and Nanotechnology PHI
6. Electron Microscopy and analysis, 2nd ed. Taylor and Francis, 2000.
7. Bio-Inspired Nanomaterials and Nanotechnology, Edited byYong Zhou, Nova Publishers.
8. Quantum dot heterostructures, Wiley, 1999.
9. Modern magnetic materials: principles and applications, John Wiley & Sons, 2000.
10. Nano: The Essentials: Understanding Nanoscience andNanotecnology, T.Pradeep, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2008.
11. Nanobiotechnology, concepts, applications and perspectives, Wiley-VCH, 2004.

DSE2P: Nanoelectronics Lab **Credits 02**

Practical:

1. Synthesis of at least two different sizes of Nickel Oxide/ Copper Oxide/ Zinc Oxide Nano Particles Using Sol-Gel Method
2. Polymer synthesis by suspension method / emulsion method
3. Electrical Charactrisation of nanomaterials.
4. Magnetoresistance of thin films and nanocomposite, I-V characteristics and transientresponse.
5. Particle size determination by X-ray diffraction (XRD) and XRD analysis of the given XRD spectra
6. Determination of the particle size of the given materials using He-Ne LASER.
7. Selective area electron diffraction: Software based structural analysis based on TEM based experimental data from published literature. (Note: Later experiment may be performed in the lab based on availability of TEM facility).

8. Surface area and pore volume measurements of nanoparticles (a standard sample and a new sample (if available)).
9. UV-VIS Spectroscopic characterization of metallic, semiconducting and insulating nanoparticles

Or

DSE-2: Transmission Lines, Antenna and Wave Propagation Credits 06

DSE2T: Transmission Lines, Antenna and Wave Propagation Credits 04

Course Contents:

Electromagnetic Wave Propagation
Radio wave propagation : modes of propagation ,ionosphere refractive index, MUF,critical frequency,virtual height, ducting
Propagation in Good Conductors, Skin Effect, Reflection of uniform Plane Waves at normal incidence, Plane Wave reflection at Oblique Incidence, Wave propagation in dispersive media, concept of phase velocity and group velocity.

Transmission Lines
Typical Transmission lines- Co-axial, Two Wire, Microstrip, Coplanar and Slot Lines, Transmission Line Parameters, Transmission Line Equations, Wave propagation in Transmission lines, lowloss, lossless line, Distortionless line, Input Impedence, Standing Wave Ratio ,Power. and lossy lines, Shorted Line, Open-Circuited Line, Matched Line, Smith Chart, Transmission Line Applications.

Waveguides and Waveguide Devices
Wave propagation in waveguides, Parallel plate waveguides, TEM, TM and TE modes, Rectangular waveguides, circular waveguides, Power transmission and attenuation, Rectangular cavity resonators, directional couplers, isolator, circulator.

Radiation of Electromagnetic waves and Types of Antenna
Radiation of electromagnetic waves: Concept of retarded potentials, Antenna Parameters: Radiation Mechanism, Current Distribution on a Thin Wire Antenna, Radiation Pattern, Radiation Power Density, Radiation Intensity, Beamwidth, Directivity, Antenna Efficiency, Gain, Beam Efficiency, Bandwidth, Polarization, Input Impedance Antenna Radiation Efficiency, Effective Length and Equivalent Areas, Maximum Directivity and Maximum Effective Area, Friis Transmission Equation and Radar Range Equation

Types of Antenna: Hertzian dipole, half wave dipole, Quarter-wave dipole, Yagi-Uda, microstrip, Parabolic antenna, Helical antenna, Antenna array.

Suggested Readings:

1. M. N. O. Sadiku, Principles of Electromagnetics, Oxford University Press (2001)
2. Karl E. Longren, Sava V. Savov, Randy J. Jost., Fundamentals of Electromagnetics with MATLAB,PHI
3. W. H. Hayt and J.A. Buck, Engineering Electromagnetics, Tata McGraw Hill (2006)

4. D. C. Cheng, Field and Wave Electromagnetics, Pearson Education (2001)
5. J. A. Edminster, Electromagnetics, Schaum Series, Tata McGraw Hill (2006)
6. N. Narayan Rao, Elements of Engineering Electromagnetics, Pearson Education (2006)
7. G. S. N. Raju, Antennas and Propagation, Pearson Education (2001)
8. Pramanik, Electromagnetism: Problems with Solutions, 3rd ed.• PHI

DSE2P: Transmission Lines, Antenna and Wave Propagation Lab **Credits 02**

Practical:

1. Program to determine the phasor of forward propagating field.
2. Program to determine the instantaneous field of a plane wave.
3. Program to find the Phase constant, Phase velocity, Electric Field Intensity and Intrinsic ratio.
4. Program to find skin depth, loss tangent and phase velocity.
5. Program to determine the total voltage as a function of time and position in a loss less transmission line.
6. Program to find the characteristic impedance, the phase constant an the phase velocity.
7. Program to find the output power and attenuation coefficient.
8. Program to find the power dissipated in the lossless transmission line.
9. Program to find the total loss in lossy lines.
10. Program to find the load impedance of a slotted line.
11. Program to find the input impedance for a line terminated with pure capacitive impedance.
12. Program to determine the operating range of frequency for TE10 mode of air filled rectangular waveguide.
13. Program to determine Directivity, Bandwidth, Beam width of an antenna.
14. Program to determine diameter of parabolic reflector.
15. Program to find out minimum distance between primary and secondary antenna.
16. Simple problems using Smith Chart.

Or

DSE-2: Control Systems Credits 06

DSE2T: Control Systems **Credits 04**
Course Contents:

Introduction to Control Systems

Open loop and Closed loop control systems, Mathematical modeling of physical systems (Electrical, Mechanical and Thermal)block diagram representation & signal flow graph, Reduction Technique, Mason's Gain Formula. Effect of feedback on control systems.

Time Domain analysis & Concept of Stability

Time Domain Analysis: Time domain performance criteria, transient response of first, second & higher order systems, steady state errors and static error constants, Performance indices.
Concept of Stability: Asymptotic stability and conditional stability, Routh – Hurwitz criterion, relative stability analysis, Root Locus plots and their applications.

Frequency Domain Analysis:

Correlation between time and frequency response, Polar and inverse polar plots, frequency domain specifications, Logarithmic plots (Bode Plots), gain and phase margins, Nyquist stability criterion, relative stability using Nyquist criterion, constant M & N circles.

State Space Analysis, Controllers and Compensation Techniques

State Space Analysis: Definitions of state, state variables, state space, representation of systems, Solution of time invariant, homogeneous state equation, state transition matrix and its properties.
Controllers and Compensation Techniques: Response with P, PI and PID Controllers, Concept of compensation, Lag, Lead and Lag-Lead networks

Suggested Readings:

1. J. Nagrath& M. Gopal, Control System Engineering, New Age International, 2000
2. K. Ogata, Modern Control Engineering, PHI 2002
3. B. C. Kuo , "Automatic control system", Prentice Hall of India, 2000.
4. Nise Control System Engineering Wiley
5. B.Manke Control System Khanna Publishers

DSE2P: Control Systems Lab **Credits 02**

Practical:

Implementation using Hardware and circuit simulation software

1. To study characteristics of:
   - **a.** Synchro transmitter receiver,
   - **b.** Synchro as an error detector
2. To study position control of DC motor
3. To study speed control of DC motor
4. To find characteristics of AC servo motor
5. To study time response of type 0, 1 and 2 systems

6. To study frequency response of first and second order systems

7. To study time response characteristics of a second order system.

8. To study effect of damping factor on performance of second order system.

9. To study frequency response of Lead and Lag networks.

10. Study of P, PI and PID controller.